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ABSTRACT

This paper summarizes two studies which examine children's free recall of letter sequences in an auditory presentation. In both studies, sequences of six or eight letters were presented to 80 third-grade and 80 eighth-grade pupils, at the rate of one item every other second or four items per second. In the first study, where recall was either immediate or delayed by five seconds, results for third graders showed no difference in number of items recalled as a function of presentation rate. Immediate recall was, however, slightly favored. For eighth graders, delayed recall was markedly better (perhaps as a result of rehearsal). The second study examined the effect of spoken recall on retention. For both age groups, no overall differences in order or item recall were apparent as a function of recall modality. At a slow presentation rate, however, eighth graders' spoken recall was poorer than their written recall. Conversely, spoken recall was superior to written recall at the fast presentation rate. Results suggest the presence of an auditory-specific, short-term memory store that holds information according to order of presentation, is subject to decay, and, apparently, is resistant to interference effects. (KS)

Developmental Changes in the Effects of Output Interference on Recall Following an Auditory Presentation

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When information is presented auditorially for free recall, interesting age-related differences occur as a function of varying presentation rate. In prior research (Gounard, 1971), I have observed that young children, 8 to 9 years of age, show a pronounced tendency to recall letter sequences serially (i.e., with a relatively large proportion of the items in order and with pronounced primacy effects) regardless of the presentation rate. Older children (13 to 14 years of age) and college students, on the other hand, show this tendency much more at a very fast presentation rate (4 items per second) than at slower rates (1 item per second and 1 item every other second).

These results, combined with observations by myself and others (e.g., Mackworth, 1964), that fast presentation rates do not necessarily adversely affect the amount that adults recall when (and only when) an auditory presentation is used, led me to believe that an effective auditory-specific store is available in circumstances that are unfavorable to the use of rehearsal and recoding strategies. These circumstances exist for children at all presentation rates because they are inefficient in using rehearsal and recoding strategies, and for adults at fast presentation rates when there is simply no opportunity to do much rehearsing and recoding. The nature of this storage would presumably be closely linked to auditory input characteristics. It appears that material would be held according to the temporal organization of input (i.e., in order) until or unless

additional processing occurred. In this latter case, the usual verbal short-term memory store would presumably predominate over the auditory-specific store, and less order information might be evident in recall.

The type of store I am describing would be like the auditory short-term store that Margrain (1967), Murdock (1968), and Penney (1975) have postulated in that the information contained would be processed to the point of identification, and the duration of the store would be as long as several seconds. It would not be auditory specific in the sense of Aaronson's (1974) sensing buffer, Crowder and Morton's (1969) precategorical acoustic store, or Neisser's (1967) echoic memory.

In my previous research, there was an indication that if children rely heavily on an auditory-specific store, the material in this store is subject to decay since the amount of order information retained by young children declines across all serial positions in a list as presentation rate decreases. However, if the storage of information for these children is closely related to the sensory modality of input, then it is also important to consider whether interference plays a role in influencing the retention of information.

I am going to report two studies to you today on children's free recall following an auditory presentation. In the first study, recall was either immediate or after an unfilled delay of 5 seconds, the purpose being to examine the results for evidence of decay effects. In the second study, recall was either written or spoken, on the assumption that interference effects would be shown whenever spoken recall was worse than written recall.

In both studies, sequences of six or eight letters were presented to

80 Grade 3 and 80 Grade 8 children respectively at rates of 1 item every other second and 4 items per second. All treatment variables were manipulated between subjects and subjects were tested individually. Each subject was presented with two practice lists and eleven test lists; recall time was 32 to 33 seconds per list. For each subject, the number correct in each serial position was totalled using both order and item scoring methods. Separate analyses of variance were performed on the data for the Grade 3 and Grade 8 children since the number of serial positions was different for each grade.

In the first study, in which recall was either immediate or delayed, the results obtained for the Grade 3 children showed no differences in the number of items recalled as a function of the recall conditions. However, the Grade 3 children recalled significantly less order information when recall was delayed than when it was immediate, F (1, 72) = 3.98, $p < .05$. This difference in favor of immediate recall was evident across all serial positions. (The interaction of recall conditions x serial position was not significant with order scoring.)

These results from the Grade 3 children are consistent with the interpretation that there is an auditory-specific store which retains primarily order information and is subject to decay.

For the Grade 8 children, there were no overall differences in the amount of order or item information recalled as a function of the recall conditions. However, the recall condition x rate interaction was significant with order scoring, F (1, 72) = 5.88, $p < .025$. At the slow presentation rate, the amount of order information recalled was slightly less when recall was delayed than when it was immediate; at the fast presentation

rate, recall of order information was markedly better when recall was delayed than when it was immediate. The Grade 8 children did not show a decline in performance under the delayed as compared with the immediate recall condition at the fast presentation rate, as one might expect if an auditory-specific store is used at this rate. In fact, recall of order information was greater for delayed than for immediate recall at the fast presentation rate. However, it must be considered that the interval with delayed recall was unfilled, and that Grade 8 children are skilled rehearsers who are unlikely to waste the opportunity for rehearsal presented by an unfilled 5-second delay. Since order information is apparently stored at a fast presentation rate, the type of rehearsal these children engaged in might have favored the retention of such information (e.g., cumulative rehearsal). At slower rates, a variety of strategies are available and these strategies would not necessarily emphasize the retention of order information. Since the instructions given do specify free recall, there is really no reason why the children should try to remember order information under any circumstances.

In my second study on written and spoken recall, I was prepared to find that spoken recall would interfere with the retention of material in the auditory-specific store. However, I found absolutely no differences as a function of recall modality for Grade 3 children in their recall of either order or item information. For the Grade 8 children, there were also no overall differences in order or item recall as a function of recall modality. However, for the Grade 8 children, the interaction of recall modality x rate was significant with item scoring, F (1, 72) = 12.10, $p < .005$. At the slow presentation rate, spoken recall was poorer than written recall

whereas spoken recall was superior to written recall at the fast presentation rate. With item scoring, the recall modality x serial position interaction was also significant, F (7, 504) = 3.82, p < .005. Greater primacy and less recency were evident with spoken than with written recall. With order scoring, there was again a significant interaction of recall modality x rate for the Grade 8 children, F (1, 72) = 6.36, p < .025. At the slow presentation rate, spoken recall was again poorer than written recall whereas spoken recall was superior to written recall at the fast presentation rate.

These results appear to suggest that spoken recall does not have an interfering effect in exactly those situations in which the auditory-specific store would be used, that is, for young children at all presentation rates and for older children and adults at a fast presentation rate. However, interference produced by spoken recall is evident for the material that would be stored in the usual verbal short-term memory store, that is, for material presented at a slow rate to the older children.

In conclusion, I have presented evidence for an auditory-specific short-term store that holds material according to the order of presentation, is subject to decay and apparently resistant to interference effects, and operates in conjunction with the usual verbal short-term memory store when an auditory presentation is used.

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